TELEMETRY DISTRIBUTION FORMAT
PACKET DEFINITION

OVERVIEW

Telemetry data retrieved from merged flat files or the data warehouse by both users and applications can be delivered using the Telemetry Distribution Format (TDF). This format consists of a stream of time-sequenced packets that can contain "all points" or "changes only" telemetry in either file or stream mode. Other formats have also been defined to provide greater flexibility to users of the data. TDF is similar in structure to the format used for data produced by the Front End Processor, which is referred to as the FEP Output Format (FOF). FOF differs from TDF in the following ways: (1) the FOF Header Record contains two additional time fields used in the merge process; (2) the TDF Element Record contains an 8-character Mnemonic ID and the FOF does not; and (3) the FOF Element Record contains both the raw and EU-converted values in separate fields while the TDF contains only one field that can hold either one (if both are desired, two element records would be required). Details of the FOF are provided in a separate document.

DETAILS

Each telemetry packet consists of a header segment containing information about the packet followed by telemetry element segments. Each telemetry element segment contains one spacecraft telemetry or derived parameter in either raw form or as a converted and appropriately formatted Engineering Unit value, along with its numeric and mnemonic identifiers and associated flags.

There is a packet for each unique spacecraft time for which telemetry data is received. For 4 Kbps telemetry, this is one packet per minor frame; for 32 Kbps data, there are two packets per minor frame. This is because 32-Kbps minor frames contain super-commutated parameters that occur twice in the minor frame resulting in an effective sampling rate of 40 Hz. The second occurrence of each of these super-commutated parameters is stored in a separate packet with a time that is 25 ms later than the first packet. Thus while minor frames are generated at 20 Hz, the resulting FOF packets are generated at 40 Hz.

The data stream consists of a sequence of packets each consisting of a header segment corresponding to a specific spacecraft time followed by a telemetry element segment for each requested parameter corresponding to that time.

Descriptions of the TDF packet formats are provided in Table 1 below.

Table 1. Definitions of Fields in the TDF

Item Name	Bit Size	Type	Item Description
TDF Packet Header Segment			
Spacecraft	64	IEEE Flt. Pnt.	Time defined by the vehicle clock count converted to UTC and expressed as modified Astronomical Julian

Item Name	Bit Size	Type	Item Description
Time			Day. For test data, this field will contain CCS Time when presented to the user if the data capture process was configured to store the data by CCS time during the test.
Number of Elements	16	positive integer	Number of Telemetry Element Segments in the packet
Data Source	8	bits	Identifies various characteristics of the data source as shown in Table 2.
Telemetry Format	8	positive integer	Identifies telemetry format. Integer codes between 0 and 255 will be assigned to all existing formats as shown in Table 3. Additional codes will be assigned for new formats as necessary.
TDF Element Record			
Data Value	64	IEEE Flt. Pnt. or ASCII	Parameter value in either raw form or converted to engineering units; format depends on value of Data Type field
Mnemonic ID	80	ASCII	Human readable abbreviation identifying the parameter
Numeric ID	16	positive integer	Unique numeric identifier for the parameter
Flags	16	bits	Associated flags (see Table 4)
Data Type	8	ASCII	Indicates the format of the Data Value field; R = raw; F = 4-byte float; D =8-byte double precision; C= 8-byte character; **NOTE: the requirement for double precision has not been established and is being included for possible future expansion.**

Notes

1. Numeric ID is a unique integer assigned to each telemetry point for the life of the mission even if the point is subsequently eliminated.
2. The Mnemonic ID consists of 8-bytes that identify the specific element and an additional two bytes to distinguish processed forms of that element such as 10-second averages. The Mnemonic ID is not stored in the data base with the telemetry data, but is generated only for display and identification purposes. It can be produced by table lookup at retrieval time so the software is simple. Originally, it was proposed to have only the Numeric ID. When users requested the Mnemonic ID, the Numeric ID was retained since it is only two bytes and might be useful to some people.
3. Data gaps are identified in two ways: a Boolean gap pseudo-parameter, which can be retrieved as an element segment, indicates gaps at the data stream level (missing minor frames), whereas initial and final point flags indicate missing values for an individual element.

It is possible for either mechanism to indicate a gap but not the other. For example, several minor frames may be lost without losing values for a parameter that is sampled so infrequently that the gap fits between adjacent measurements of that parameter. In this case, the gap pseudo-parameter will indicate the missing minor frames, however, only those parameters for which values were actually lost will show a gap indicated by the initial and final point flags.

Likewise, if only a portion of a minor frame is corrupted, there will be gaps in the affected elements indicated by initial and final point flags even though the gap pseudo-parameter won't indicate missing minor frames.

For packets containing valid engineering telemetry data, the gap pseudo-parameter will have the value zero. During a gap, there will be "gap packets" containing only one element, the gap pseudo-parameter, with the value set to one.

4. The data source flags are all set in the FEP and simply transferred from the FOF to the TDF.

Table 2. Definitions of Flags in the FOF/TDF Header Data Source Field

BIT	FLAG NAME	DESCRIPTION
0 (lsb)	Spacecraft Data Mode	0 indicates recorded data (ETR/SSR) 1 indicates Real-Time data
1	Ground Station Mode	0 indicates direct feed through ground station 1 indicates replay of ground station recorded data
2	CCS Mode	0 indicates operational data 1 indicates test data
3	FEP Mode	0 indicates external data source 1 indicates FEP is replaying pre-recorded data for testing
4	FEP Replay	Set to 1 if data is being supplied in response to an FEP replay request
5	Era	0 if data was captured by CCS 1 if data was converted AEDP/ESS data
6-7	Spare	

Table 3. Telemetry Format Identifier Code Definitions for the FOF/TDF Header

Code	Format	Code	Format	Code	Format	Code	Format
0	off	37	HF	80	PN	163	U

5	XN	40	FN	81	PF	186	ZN
6	XF	41	FF	82	NSSC-1 Dmp	187	ZF
24	TN	48	C	138	M	192	AN
25	TF	64	YN	145	S	193	AF
36	HN	65	YF	146	D/E	others	spare

Table 4. Definitions of Flag Bits in the FOF/TDF Element Flags Field

BIT	FLAG NAME	SET BY	DESCRIPTION
0 (lsb)	Corrected Spacecraft Time	FEP and Merge	Set to 1 if VCC was bad and S/C Time has been corrected; also used for D/E format data
1	Quality	FEP	Set to 1 if data quality is questionable
2	Limit Low	FEP	Set to 1 if out of limits low
3	Limit High	FEP	Set to 1 if out of limits high
4	Limit Level	FEP	Set to 1 if beyond severe limit (red)
5	Delta Error	FEP	Set to 1 if delta limit exceeded
6	Alternate limits	FEP	Set to 1 if alternate limits should be used
7	EU Conversion Error	FEP	Set to 1 for conversion error
8	No EU Conversion	FEP	Set to 1 if no EU conversion is defined in the PRD for this element
9	Initial Point	FEP	Set to 1 if first point after data gap, start of contiguous span
10	Final point	Merge	Set to 1 if last point before gap, end of contiguous span
11	Reconstructed Point	Data Mgt	Set to 1 if this point was added to "changes only" data to construct "all points" data.
12-15	Spare		